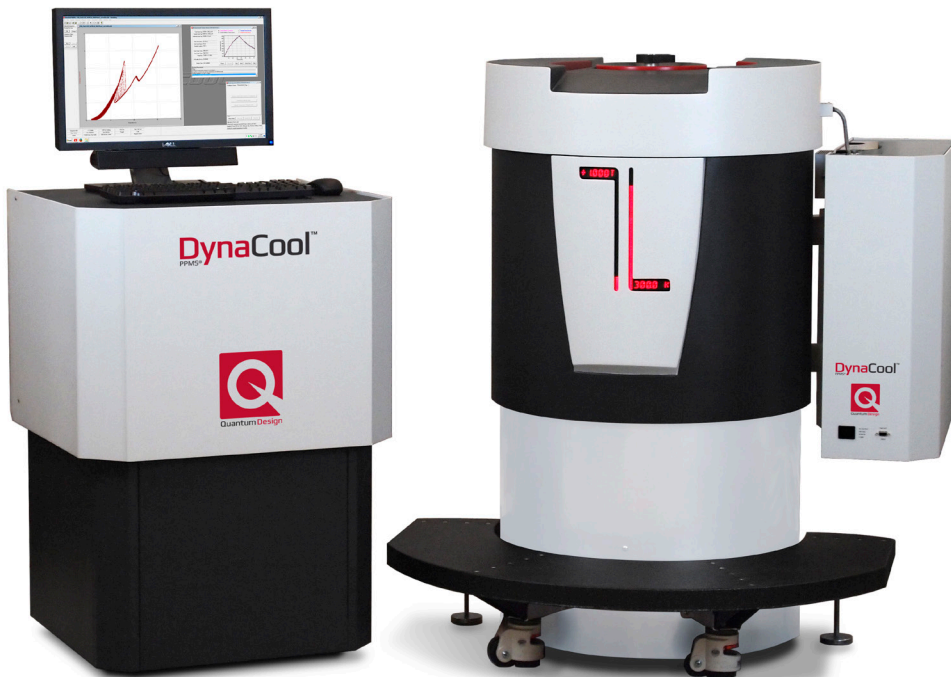# FastHall™ Analysis Kits for Hall Measurement Integration with Quantum Design PPMS®

MeasureL²NK™

+

Introduction

Cut your measurement time up to one half with the MeasureReady® M91 FastHall™ measurement controller. Measurements are so fast, time-dependent misaligment errors are eliminated using the patented FastHall™ measurement technique.

- FastHall eliminates the need for field reversal
- Up to 100× faster for low-mobility materials
- Lower mobilities can be measured using lower fields

Combine the measurement power of a FastHall Controller with Quantum Design's Physical Property Measurement System (PPMS). In partnership with Quantum Design, the M91 can now be seamlessly integrated with a PPMS measurement application. Two kits are available to easily integrate the M91 into a PPMS:

- Standard resistance: low-cost option that uses a Lake Shore feedthrough box to connect the M91 to the PPMS
- High resistance: low-noise, fully guarded Lake Shore insert

M91 electrical measurement specifications

The M91 FastHall measurement controller integrates all the required source measure and signal switching capabilities to provide a complete start-to-finish Hall analysis.

Resistance (R)

Standard: 10 mΩ to 10 MΩ source current

High resistance*: Up to 200 GΩ source voltage

Mobility (μ)

Mobility range: 10^6 cm^2/(V s) to 0.001 cm^2/(V s)
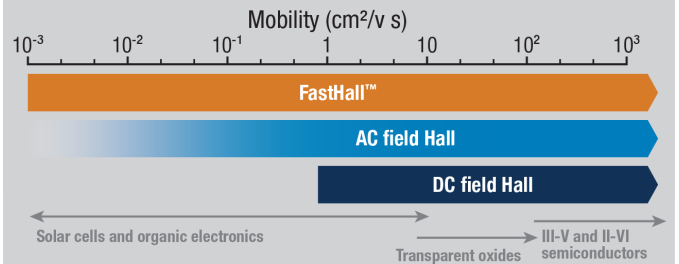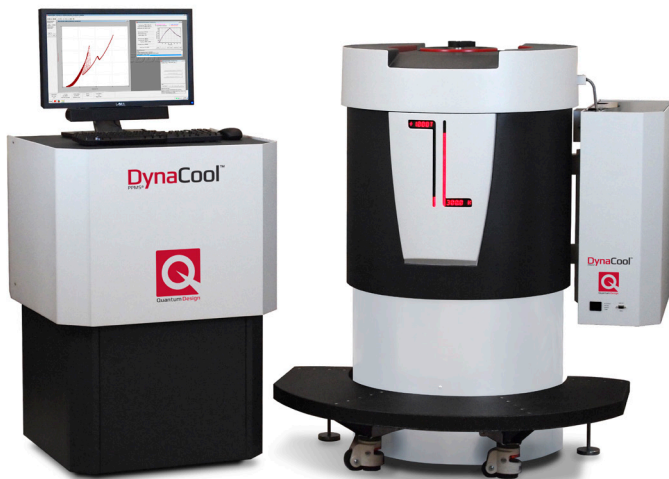
Parameters

Current source range: 1 μA to 100 mA (lowest usable: 10 nA)

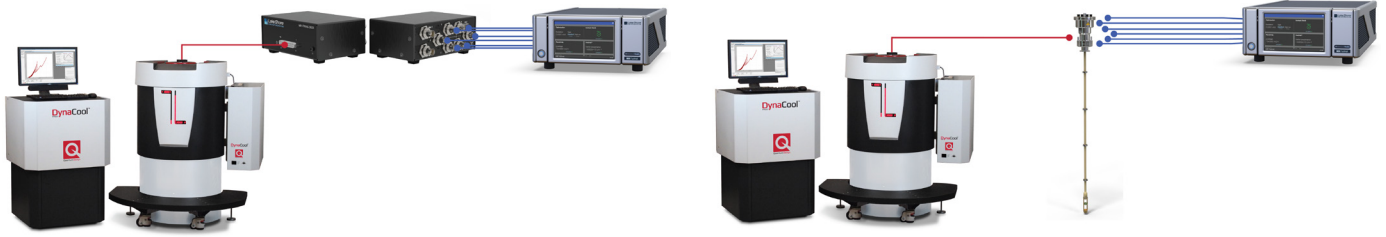Current measurement range: 100 mA to 10 nA (lowest measureable: 1 pA)

Voltage source range*: 10 mV to 10 V

Voltage measurement range: 1 mV to 10 V

* Only available with M91-HR (high resistance) model

Connection kit comparison

	Standard resistance **up to 10 MΩ**	High resistance **up to 200 GΩ**
Benefits	Benefits with M91 integration: ■ Cut measurement time up to one half with no field reversal needed ■ Switching technique minimizes thermal drift ■ Eiminates manual trial-and-error steps with optimized calculations	Additional benefits with M91 + Lake Shore insert: ■ Fastest measurements with reduced settling times ■ Best performance for low-noise, low-current measurements ■ Fully guarded from instrument to sample
Cost	$	$$
Resistance range	10 mΩ to 10 MΩ	10 mΩ to 200 GΩ
Integration	M91/PPMS integration with feedthrough box	M91/PPMS integration with low noise, fullly guarded insert
FastHall model	M91 (standard)	M91-HR (high resistance)
FastHall excitation	Current source	Current source, voltage source
Sample mounting	PPMS sample puck	Lake Shore sample board
Signal path	Standard twisted pair wiring	Fully guarded (internal coaxial) from intrument to sample
Mobility	10^6 cm²/(V s) to 0.001 cm²/(V s)	
Sample types	Supports van der Pauw and Hall bar samples	
Temp sensor	Integrated Cernox® temperature sensor local to sample	
Control software	FastHall's MeasureLINK® software for Hall measurement control integrates easily with the PPMS MultiVu™ application software	

Standard resistance kit — PPMS/M91 integration via Lake Shore feedthrough box

PPMS	M91-TRIAX-DB25	Lake Shore M91

back
(1) LEMO connection

front
(6) triaxial connections

Diagram 1: PPMS connected to the M91 via feedthrough box

Features

- Low-cost option
- Compatible with Quantum Design PPMS puck
- M91 resistance measurements up to 10 MΩ

Sample connections

The M91 supports both van der Pauw (4 connections) and Hall bar (6 connections) geometries. These samples should be wired to Quantum Design's PPMS sample puck as shown in Diagram 2. When inserted into the PPMS, these sample connections are present on the LEMO connector on the side of the PPMS. The M91-TRIAX-DB25 feedthrough box enables these pins to connect to the M91. Six triaxial cables are included in the kit. Note: guarding is only up to the feedthrough box.

Gray LEMO (puck) pins	FastHall triaxial
3 (CH 1, I+)	1
7 (CH 2, I+)	2
8 (CH 2, I-)	3
12 (CH 3, I-)	4
4 (CH 1, I-)	5
11 (CH 3, I+)	6
10 (CH 2, V-)	AUX 1
9 (CH 2, V+)	AUX 2
6 (CH 1, V-)	Measure common

Note:
Internal jumper on measure common:

Gray LEMO pin 6, puck CH 1, V-

P1-user bridge D shield, pin 13
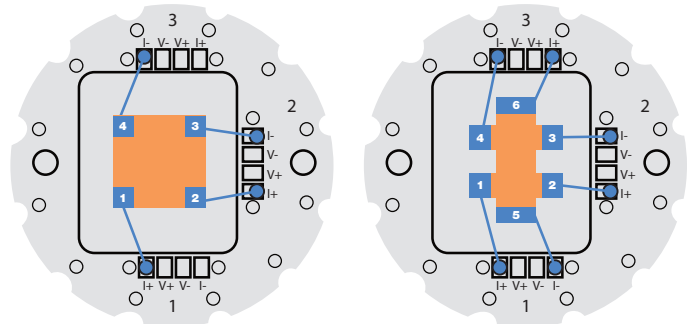
Diagram 2: Pinning for PPMS sample puck

High resistance kit — PPMS/M91 integration via Lake Shore insert

PPMS **Lake Shore M91-HR**

Diagram 3: PPMS connected to the M91 with the Lake Shore insert

Features

- Fully guarded from instrument to sample for ultra-low noise measurements

- M91-HR resistance measurements up to 200 GΩ

- Samples mount to consumable Lake Shore sample carrier boards (also pin compatible with Quantum Design sample carrier boards); 12 are included

Specifications summary

Pin-to-pin leakage current (base temp)	50 fA
Pin-to-insert body leakage current (base temp)	50 fA
Max current per pin	100 mA
Max voltage between any 2 pins and insert body	50 V
Operating temperature range	1.9 K to 400 K

Sample connections

Diagram 3 generally shows how the PPMS/M91 connection is made via the insert (Diagram 4) supplied by Lake Shore.

The M91 supports both van der Pauw (4-connection) and Hall bar (6-connection) geometries. These samples are wired to the Lake Shore sample board (Diagram 5). The sample board then snaps into the sample insert board located on the probe (Diagram 6).

When the insert is loaded into the PPMS, these sample connections are fully guarded up to the M91 via triaxial cables (included in kit). The integrated Cernox® sensor connections go to the PPMS, enabling temperature readings directly through MultiVu. Diagram 7 shows a close up view at the working end of the insert.
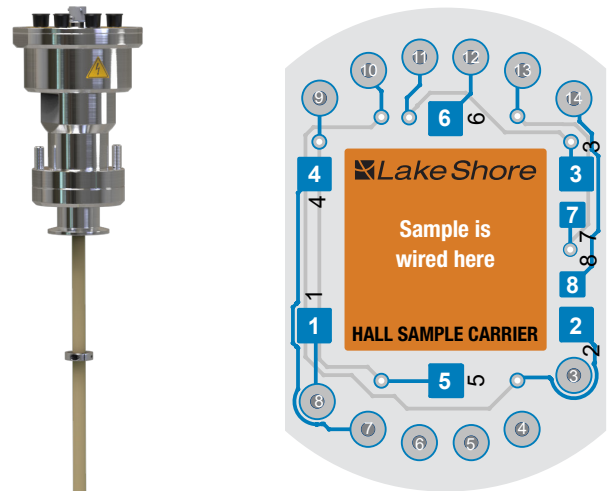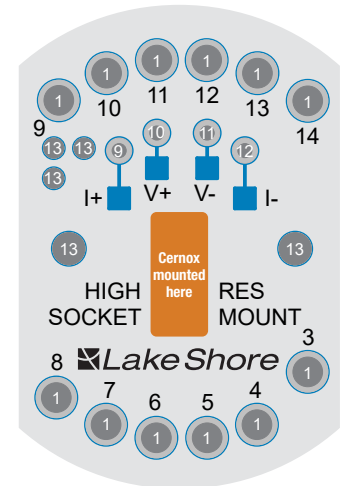

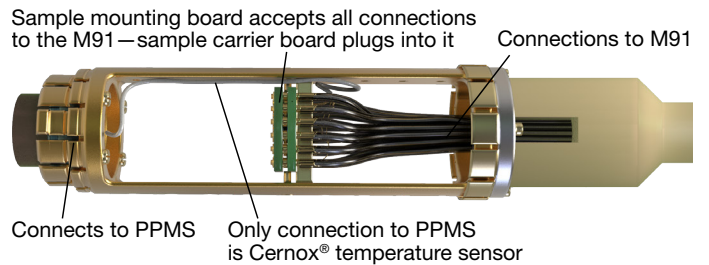*Diagram 5: Sample carrier board*

Diagram 6: Sample mount board

Diagram 4: Lake Shore insert

Sample mounting board accepts all connections to the M91—sample carrier board plugs into it

Connections to M91

Connects to PPMS

Only connection to PPMS is Cernox® temperature sensor

Diagram 7: Insert connections

M91 rear panel
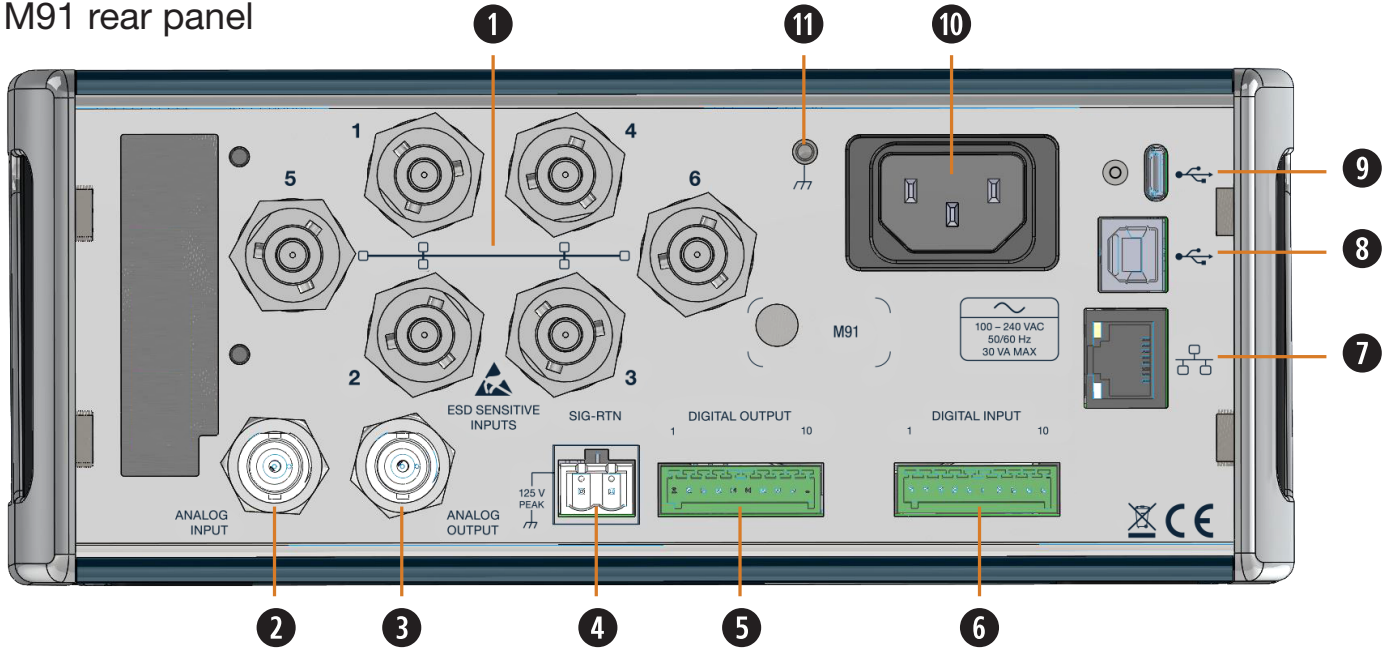
❶ Triaxial sample connectors   ❺ Digital output   ❾ USB thumb drive interface

❷ Analog input   ❻ Digital input   ❿ Line input assembly

❸ Analog output   ❼ RJ-45 Ethernet interface   ⓫ Chassis ground connection

❹ Signal RTN   ❽ USB communications interface

Diagram 8: Back panel of M91 instrument

Field-dependent transverse and longitudinal transport measurements for a GaAs 2-D electron gas system at 2 K with 1 µA sourced excitation current in the van der Pauw geometry. Plateaux in the transverse channel demonstrate the integer quantum Hall effect and correspond to where the Fermi level falls in an area of localized states between neighboring Landau levels.

Sample provided by Dr. M. Pendharkar,Chris Palmstrøm Group,University of California Santa Barbara.
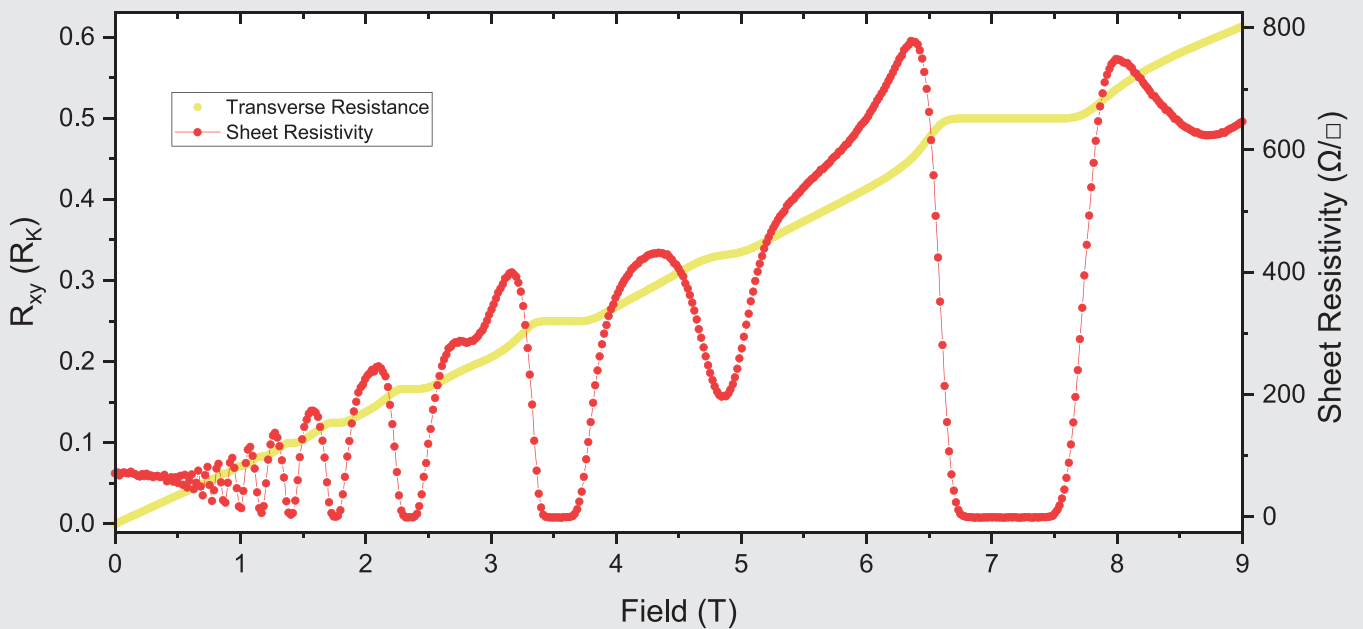
MeasureLINK software

The M91's MeasureLINK™ software for Hall measurement control integrates easily with the PPMS MultiVu application software. MeasureLINK can be installed on the same PC with the MultiVu software or on a separate PC that is on the same network as the MultiVu PC.

Once installed, MeasureLINK:

- Provides a simple way to start and step through your measurement sequences, as well as chart, log, and organize the result

- Includes scripts for running Hall measurements and reporting the result

- Enables automated control of field and management of sample temperature

- Generates detailed reports including all the supporting intermediate data so you can readily confirm the integrity of the final results

- Allows for customization of measurement sequences for specific Hall research requirements (optional upgrade)

Home screen

Three main functions:

- Sample setup
- Sequencing
- Scripting

Sample setup screen

Associate sample information with a measurement sequence

Enter new sample information directly

Import sample information from previously-saved file

Sequence screen

Build a sequence of steps that define the desired measurement protocol

Choose from:

Measurement functions

- Built-in functions

Control functions

- Go to field or temperature
- Loop field or temperature

Custom measurements

- Modified or specialized routines, previously defined by scripts
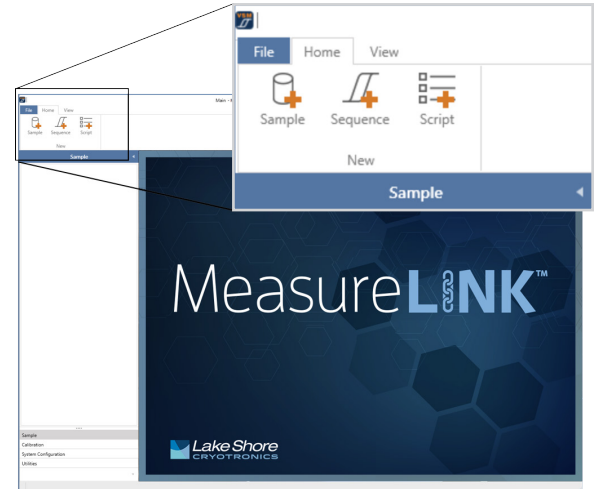
Script screen

Extend your system functionality by creating custom scripts

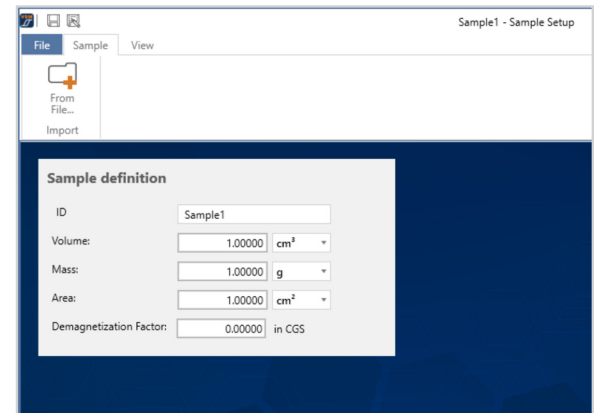- Implement nearly any measurement
- Integrate third-party instruments

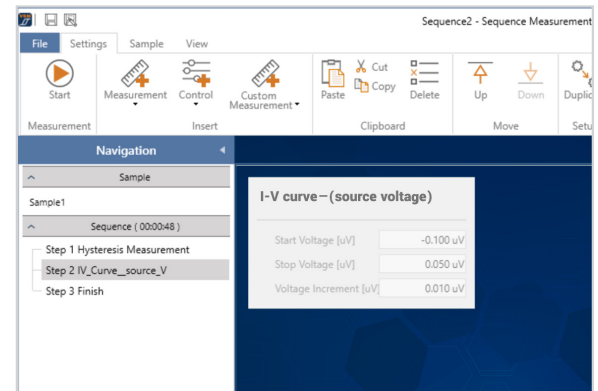Modify existing scripts

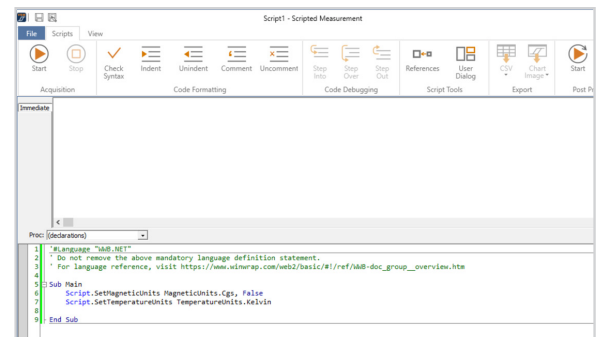Import other scripts

Simpler and faster than writing code

Home screen

Sample setup screen

Sequence screen

Script screen
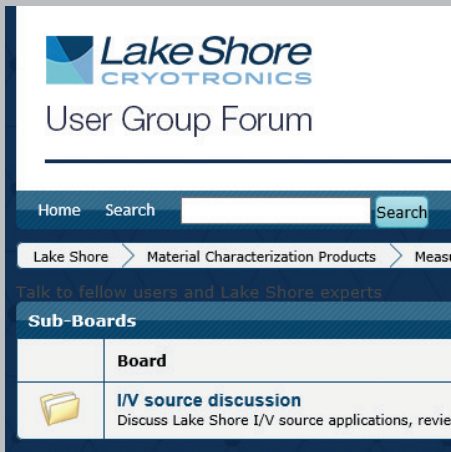
Questions? Answers?

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and become part of the conversation!